

CLAIMS

1. A top-emitting OLED device, comprising:
 - a) a transparent or an opaque substrate;
 - b) a reflective, opaque, and conductive anode layer including a
5 metal or metal alloy or both formed over the substrate;
 - c) a plurality of hole-injecting layers disposed over the reflective, opaque, and conductive anode layer, including a bilayer structure having a layer including an oxide and a layer including a fluorinated carbon;
 - d) a plurality of organic layers formed over the plurality of
10 hole-injecting layers and including an emissive layer having electroluminescent material;
 - e) a reflective, semitransparent and conductive cathode including a metal or metal alloy or both provided over the plurality of organic layers; and
 - f) the plurality of the hole-injecting layers being configured to
15 reduce the drive voltage, and the reflectivity of the anode, the transparency of the cathode, and the thickness of the organic layers between the electrodes being selected to change the internal reflection of light to thereby improve the emission through top surface.
- 20 2. The top-emitting OLED device of claim 1 wherein the plurality of the hole-injecting layers includes an oxide and a fluorinated carbon layer.
3. The plurality of the hole-injecting layers of claim 2 wherein
25 the oxide layer is in contact with the anode and the fluorinated carbon layer, and the fluorinated carbon layer is in contact with the oxide and the hole-transport layer.
4. The top-emitting OLED device of claim 1 wherein the
30 plurality of organic layers includes a hole-transport layer disposed between the fluorinated carbon layer and the emissive layer.

5. The top-emitting OLED device of claim 1 wherein the plurality of organic layers includes an electron-transport layer disposed between the emissive layer and the cathode.
6. The top-emitting OLED device of claim 1, which further
5 includes a transmission enhancement layer (TEL) over the reflective, semitransparent and conductive cathode to further improve the amount of light, which passes through the cathode.
7. The top-emitting OLED device of claim 1 wherein the reflective, opaque, and conductive anode includes Ag, Al, Mg, Zn, Rh, Ru, Ir, Au,
10 Cu, Pd, Ni, Cr, Pt, Co, Te, Mo, Hf, Fe, Mn, Nb, Ge, Os, Ti, V, or W, or alloys or mixtures thereof.
8. The top-emitting OLED device of claim 1 wherein the reflective, semitransparent, and conductive cathode layer has of absorbance of 30% or less over visible wavelengths.
9. The top-emitting OLED device of claim 1 wherein the
15 reflective semitransparent and conductive cathode includes metal or metal alloys having a work function selected to be about 4.0 eV or less.
10. The top-emitting OLED device of claim 1 wherein the metal or metal alloys include alloys of Ag or Al with Mg, alkali metals, alkali
20 earth metals, or Mn.
11. The top-emitting OLED device of claim 2 wherein the oxides include ITO, IZO, Pr_2O_3 , TeO_2 , CuPc, SiO_2 , VO_x , or MoO_x , or mixtures thereof wherein x is less than 3.
12. The top-emitting OLED device of claim 2 wherein the
25 fluorinated carbon is CF_x wherein x is less than 3.
13. The top-emitting OLED device of claim 8 wherein the TEL includes ITO, MgO, MoO_x , SnO_2 , TiO_2 , Al_2O_3 , SiO_2 , ZnO, ZrO_2 , Alq, NPB, SiN, AlN, TiN, SiC, or Al_4C_3 , or mixtures thereof.
14. The top-emitting OLED device of claim 6 wherein the
30 thickness of the TEL ranges from 20 nm to 150 nm.

15. The top-emitting OLED device of claim 1 wherein the combined thickness of all layers between the anode and cathode is in the range of 70 nm to 150 nm or 230 nm to 330 nm.

5 16. The top-emitting OLED device of claim 1 wherein the hole transport layer includes NPB.

17. The top-emitting OLED device of claim 1 wherein the emissive layer includes Alq.

18. The top-emitting OLED device of claim 1 wherein the electron-transport layer includes Alq.

10 19. The top-emitting OLED device of claim 1 wherein the emissive layer contains fluorescent or phosphorescent dopants.

20. The top-emitting OLED device of claim 16 wherein the thickness of the hole-transport layer is in the range of 20 nm to 80 nm or 180 nm to 230 nm.

15 21. The top-emitting OLED device of claim 1 wherein the thickness of the cathode layer is in a range of from 4 nm to 50 nm.

22. The top-emitting OLED device of claim 1 wherein the thickness of the anode layer is greater than 40 nm.